HK 5: Heavy-Ion Collisions and QCD Phases II

Time: Monday 16:30–18:00 Location: J-HS G

Group Report HK 5.1 Mon 16:30 J-HS G

Constraining the Equation of State of Nuclear Matter with Heavy Ion Collisions — •Justin Mohs[1,2,3], Markus Mayer[2], and Hannah Elfner[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]Institute for Theoretical Physics, Goethe University Frankfurt am Main — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main

Heavy ion collisions at SIS 18 energies produce nuclear matter at similar temperature and density as present in neutron star mergers. The aim of this work is to constraint the equation of state of dense nuclear matter from collective flow observables. The azimuthal anisotropy is known to be very sensitive to the employed equation of state and is characterized by flow coefficients. For the calculation of flow coefficients a hadronic transport model (SMASH) is employed, where the equation of state enters the calculation in form of nuclear mean field potentials. A Skyrme potential is used with different parameter sets to vary the stiffness of the equation of state. This is a first step towards a more systematic study with a state-of-the-art description of nuclear potentials and Bayesian parameter estimation.

HK 5.2 Mon 17:00 J-HS G

Multi-particle reactions in hadronic transport approaches — •Jan Staudenmaier[2,3] and Hannah Elfner[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — [2]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Max-von-Laue-Str. 1, 60438 Frankfurt am Main — [3]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, 60438 Frankfurt am Main

Nucleus-nucleus collisions at intermediate energies are in progress at BES-II and will also be explored by upcoming experiments at FAIR and NICA. Such collisions offer an unique opportunity to study high particle densities. In such conditions multi-particle reactions are expected to become relevant. Hadronic transport approaches, however, usually only treat binary scatterings, which, in addition, also breaks detailed balance for baryon anti-baryon annihilations and decays of resonances with more than two particles in the final state.

In this talk, a stochastic scattering criterion that allows for a straight forward treatment of multi-particle reactions is presented. The hadronic transport approach named SMASH is extended to include this stochastic criterion. Infinite matter calculations are used to study the scattering rate and detailed balance for the treatment in a systematic way. Furthermore, first results for nucleus-nucleus collisions employing the stochastic criterion are shown.

HK 5.3 Mon 17:15 J-HS G

Development of attractor solutions within the kinetic Boltzmann parton cascade — •Benjamin Schüller[1], Gabriel Denicol[2], Kai Gallmeister[1] und Carsten Greiner[1] — [1]Institut für Theoretische Physik, Goethe Universität, Frankfurt/Main — [2]Instituto de Física, Universidade Federal Fluminense

We investigate the longitudinal boost invariant Bjorken expansion of a gluon gas in the transversal plane for different initial particle distributions using either a set of constant cross sections or a set of constant values for the shear viscosity to entropy ratio with the partonic transport casacade BAMPS ("Boltzmann Approach to Multi-Parton Scatterings").

As a first scenario the particle distribution is constant in the transverse plane (0+1D expansion), whereas the second scenario comprises a symmetric transversal Gaussian profile (1+1D expansion). Furthermore, we investigate the influence of different degrees of anisotropy of the momentum space on the evolution of the system. We compute the time evolution of several quantities like π/P and P_L/P_T. In doing so, we observe that irrespective of the degree of anisotropy in momentum space the different observables merge into one another as an attractor in the course of time. Finally, we compare our results to the results of relativistic viscous fluid dynamics and obtain very good agreement for the 0+1D expansion and only fair agreement for the 1+1D expansion.

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HK 5.4 Mon 17:30 J-HS G

The Shear Viscosity to Entropy Density Ratio of Hagedorn States — •Jan Rais, Kai Gallmeister, and Carsten Greiner — Institut für Theoretische Physik, Goethe Universität, Frankfurt/Main

The fireball concept of Rolf Hagedorn, developed in the 1960's, is an alternative description of hadronic matter. Using a recently derived mass spectrum, we use the transport model GiBUU to calculate the shear viscosity of a gas of such Hagedorn states, applying the Green-Kubo method to Monte-Carlo calculations. Since the entropy density is rising ad infinitum near T_H, this leads to a very low shear viscosity to entropy density ratio near T_H. Further, by comparing our results with analytic expressions, we find a nice extrapolation behaviour, indicating that a gas of Hagedorn states comes close or even below the boundary $1/4\pi$ from AdS-CFT.

HK 5.5 Mon 17:45 J-HS G

A relativistic diffusion model from nonequilibrium-statistical considerations — •Johannes Hölck and Georg Wolschin — Institut für Theoretische Physik der Universität Heidelberg, Philosophenweg 12/16

A derivation of a Fokker–Planck-type relativistic diffusion model (RDM) from nonequilibrium statistics is considered. The model describes the evolution of centrality-dependent (pseudo-)rapidity distributions of produced charged particles and net protons in relativistic heavy-ion collisions, agreeing with experimental data from RHIC and LHC at various center-of-mass energies.

By separating the system into three subsystems – two fragmentation sources and the central fireball – we account for the different physical processes in and the spatial separation of the three corresponding particle production sources. The drift and diffusion coefficient functions are addressed by considering the expected asymptotic distributions which are used to derive the fluctuation–dissipation relations of the subsystems.